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FOREST INSECT INVESTIGATIONS

PRELIMINARY STUDIES OF THE FEEDING HABITS OF THE ADULT WESTERN PINE BEETLE

by

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Introduction

Very little is known about the feeding habits of the adult western pine beetle. We know it bores out of the bark, is in flight for a period before attacking a new tree, and that it bores under the bark of living trees during the establishment of a new brood. All of this calls for the expenditure of a great amount of energy, and it may be assumed that nourishment is received by the beetle at some time during its adult life.

The purpose of this study was primarily to determine the nature of the contents of the alimentary canal by dissection and microscopic examination. An experiment to determine whether the adults feed on needles or twigs of yellow pine was also undertaken, and cultures of the intestinal tract were made to determine what micro-organisms were present.

The results described herein were carried on in the field laboratory of the U.S. Bureau of Entomology, located in the North Warner Mountains near Miller Ranch, Modoc County, California. Owing to lack of the time required to complete these studies, this is intended only as a progress report and will be of value for further studies along similar lines.

Evidence of Feeding from Microscopic Dissections

Description of material studied. The beetles used for dissection studies were fresh specimens collected as follows: (1) Adults which had barely changed from pupae; (2) adults which were boring in the bark prior to exit; (3) adults which had emerged from the bark but had not yet attacked trees (designated as beetles in flight). Beetles were also collected from two trees at different times during the egg-laying period, and were dissected some time after they had been preserved in 95% alcohol. These dissections served merely to find out the nature of the contents of the alimentary canal, and do not necessarily indicate that nutriment was derived.

Very young adults. Five beetles in this stage of development were obtained by shaving the bark away until they were uncovered. These specimens had barely emerged from the pupal stage of development and were still very soft and delicate. Under the microscope they all showed a collapsed condition of the alimentary canal, with no indication of food substance within them, and they were all alike in having the abdominal and thoracic cavities much distended with disorganized fatty tissue. This was to be expected, since the mandibles had not yet hardened sufficiently to allow feeding.

Adults prior to exit. The ten adults examined at this stage of development had the entire length of their digestive tracts filled with borings. Whether nourishment is derived from this dry outer bark is not known.

Adults in flight. The ten specimens chosen for this dissection were for the most part taken from a rearing cage. The beetles were allowed to collect on the walls of the cage after emerging from the bark. Most of the digestive tracts examined were devoid of any of the bark material. In a few cases the rectum contained small particles of bark, indicating that these had probably bored out of the bark very recently.

Adults extending brood galleries. For the purpose of this study two trees were chosen for collections and designated respectively as T-1 and T-2. T-1 was attacked approximately on the twentieth of June. Two collections were taken from it, one on July 13 and another on July 19. By the latter date egg-laying had been practically completed, and larvae as much as one-half grown were found. Tree T-2 was attacked about July 4. Three collections were taken from it on July 12, 19 and 28. By the latter date egg-laying had ceased. Ten specimens from each of the above-mentioned collections were dissected, and the alimentary tracts without exception were found to be filled with soft inner bark.

Feeding Test on Yellow Pine Sapling

The object of this experiment was to determine whether adults in flight may feed on needles or twigs of yellow pine. For this purpose a cage 3x3x6 feet was constructed, having one end open. A door was provided, so that examination could be made without removing the cage. The cage was placed over a small yellow pine sapling two inches in diameter at the base and slightly more than five feet tall. The bottom of the cage was buried beneath the surface of the ground to prevent the beetles from escaping.

On June 27, 1929, four hundred D. brevicomis adults were introduced, these having just emerged from brood bark in a rearing cage. On June 29 the tree was examined, and it was found that most of the beetles had bored below the surface of the soil at the base of the sapling. Three hundred more adults were placed in the cage. On July 9 the sapling was again examined. A large number of the beetles had bored beneath the ground surface and were working on the larger roots nearest the trunk. There was no evidence of egg-laying at this point. None of the beetles had bored

into the bark of the trunk two feet above the surface and here two definite galleries were present, one of which contained an egg. There was no evidence of feeding on the needles on any part of the sapling. Dissections were made on several of the specimens found boring in the larger roots and on the trunk. All of these revealed the presence of bark substance in the alimentary canal.

Yeasts as Normal Inhabitants of the D.b. Alimentary Canal

The question as to whether D.brevicomis adults require the presence of symbiotic organisms to help assimilate the bark and wood material which is taken into the digestive system has led to investigations along these lines. Person carried on a number of cultural studies of whole adults in the laboratory at Berkeley during the winter of 1929. He found that there was one organism common to all individuals; namely, a yeast. In his experiment no definite consideration was given to the alimentary canal. Whether yeasts were found in the digestive tract and also whether bluestains were normal flora, were the objects of a number of culture studies carried on during the 1929 summer season. Two different culture media were used.

Rice starch medium. The first medium tried consisted of a gruel prepared from boiled rice, similar to that used by Nelson and Beal to culture bluestains". In each an intestinal tract of one adult D.brevicomis was placed, having been first sterilized by dipping in 95% alcohol and rinsed with sterile water. These were allowed to remain until June 7, when the medium was found unsuitable. A bluish fungus developed in one of the plates, giving the whole medium a slimy texture. The other plates remained sterile. This medium was discarded in favor of a solid medium.

Agar-agar medium. A new culture medium was prepared, consisting of the following ingredients: peptone, 10 grams; potassium phosphate, 2 grams; magnesium sulfate, .5 gram; agar-agar, 30 grams; boiled rice starch, 1000 cc. Enough citric acid was put in to produce a pH of 4.8. Six sterile petri dishes were plated with sterile agar and allowed to cool.

One June 7 the intestinal tracts of six adult D.b. were dissected out. All the beetles used were taken from the bark just before gaining exit. It was assumed that this material should be free from any other than natural intestinal organisms. The intestinal tracts were sterilized with a weak solution of mercury bichloride (1-1000) to kill any organisms that might have lodged on the outside. They were then rinsed in sterile water. Each of the six plates of agar contained a single intestine.

On June 10 two more plates of agar were prepared which contained agar media with nutrients in the proportions already mentioned. In these the intestinal tracts of two fully-grown D.brevicomis larvae were planted, using the same technic as for the adults.

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On June 12 the plates containing both the adult and larval intestines were examined. All plates without exception contained white, somewhat slimy-looking colonies. These were examined under the compound microscope and found to be a yeast. Some of the colonies were larger than others and some contained the beginnings of mycelial growth. The fungus had some resemblance to that of bluestain but could not be definitely determined.

On July 5 six more plates of D.brevicomis intestines were made, using the same media and technic as the others. On July 10 all these contained a healthy growth of yeast colonies. Yeasts are evidently the normal organisms of the D.brevicomis digestive tract, both in the larval and the adult stage of development. Fungi are occasionally present.

Summary

1. Some preliminary experimental feeding studies were carried on with the western pine beetle during the 1929 summer season.

2. The results of these studies show that the beetles feed continuously during the time they are in the bark prior to exit and while they are extending their egg galleries.

3. D.brevicomis Lec. adults do not feed on needles or twigs of yellow pine.

4. A yeast is definitely associated in the digestive tract of D.brevicomis.